

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

	) Confirmation No.: 2876
	)
Appellant: PRASHER	) Group Art Unit: 2841
	)
Application Serial No.: 10/811,597	) Examiner: Tuan T. Dinh
	)
Filing Date: March 29, 2004	) <b>APPEAL BRIEF</b>
	)
For: COOLING AN INTEGRATED	) Attorney Docket No.: P18285
CIRCUIT DIE WITH COOLANT	)
FLOW IN A MICROCHANNEL	) <b>PTO Customer Number 28062</b>
AND A THIN FILM	) Buckley, Maschoff & Talwalkar LLC
THERMOELECTRIC COOLING	) Attorneys for Intel Corporation
DEVICE IN THE MICROCHANNEL	) 50 Locust Avenue
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	)

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Mail Stop Appeal Brief – Patents (via EFS)  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Sir:

Appellant hereby appeals to the Board of Patent Appeals and Interferences from the decision of the Examiner in the Final Office Action mailed January 15, 2008 (the "Final Office Action"), rejecting claims 1-11, 15, 16 and 23-28.

## **REAL PARTY IN INTEREST**

The present application is assigned to INTEL CORPORATION, 2200 Mission College Blvd., Santa Clara, California 95052, U.S.A.

## **RELATED APPEALS AND INTERFERENCES**

No other appeals or interferences are known to Appellants, Appellants' legal representative, or assignee, which will directly affect, be directly affected by, or have a bearing on the Board's decision in the pending appeal.

## **STATUS OF CLAIMS**

Claims 1-16 and 23-28 are pending in this application. Claims 1-11, 15, 16 and 23-28 stand rejected and are now being appealed. Claims 12-14 were found by the Examiner to recite allowable subject matter, but were objected to as being dependent on a rejected base claim. Thus claims 12-14 are not involved in this appeal.

Claims 17-22 were not elected for prosecution and were subsequently canceled.

## **STATUS OF AMENDMENTS**

No amendments to the claims are pending.

## **SUMMARY OF CLAIMED SUBJECT MATTER**

Conventional cooling systems for microprocessor dies are not necessarily adequate for dealing with a problem presented by so-called "hotspots" on the microprocessor die. (Specification, page 2, lines 2-9) Hotspots are localized zones on the microprocessor die at which circuit elements raise the temperature above the average temperature on the die. (Specification, page 2, lines 2-9) Even if the average temperature on the die is kept below a

target level, excessive heating at hotspots may result in localized device malfunctions.  
(Specification, page 2, lines 2-9)

The present patent application discloses a cooling system for a microprocessor die in which a coolant flowing through microchannels adjacent the rear surface of the die is supplemented with thin film thermoelectric cooling (TFTEC) devices located in the microchannels. (Specification, page 3, line 23 to page 4, line 3; page 4, lines 23-24; page 5, lines 5-8; FIG. 1--IC die 10, microchannels 30, TFTEC devices 40) The presence of the TFTEC devices may mitigate the effects of hotspots on the die due to localized characteristics of the IC. (Specification, page 8, lines 9-10) Also, the coolant flowing on the top of the TFTEC devices may enhance the effectiveness of the TFTEC devices by aiding in dissipation of heat transported by the TFTEC devices from the IC die. (Specification, page 8, lines 10-12)

\* \* \* \* \*

Appellant will now map the limitations of the independent claims and of the dependent claims argued separately to the relevant portions of the disclosure.

Claim 1

“an integrated circuit (IC) die having a front surface on which an integrated circuit is formed and a rear surface that is opposite to the front surface”—FIG. 1: IC die 10, front surface 16, integrated circuit 18, rear surface 22; specification, page 3, lines 15-25.

“a member to define at least one microchannel at the rear surface of the IC die, the microchannel to allow a coolant to flow therethrough”—FIG. 1: microchannel member 24, microchannels 30; specification, page 3, lines 24-27; page 4, lines 23-24.

“at least one thin film thermoelectric cooling (TFTEC) device in the at least one microchannel”—Fig. 1: TFTEC devices 40; specification, page 5, lines 5-8.

Claim 2 (dependent on claim 1)

The support in the disclosure for the limitations inherited from claim 1 is described above in connection with claim 1. Claim 2 also recites:

“the at least one TFTEC device is formed on the rear surface of the IC die”—specification, page 5, lines 7-8.

Claim 23 (independent)

“an integrated circuit (IC) die having a front surface on which a microprocessor is formed and a rear surface that is opposite to the front surface”—FIG. 1: IC die 10, front surface 16, integrated circuit 18, rear surface 22; specification, page 3, lines 15-25.

“a member to define at least one microchannel at the rear surface of the IC die, the microchannel to allow a coolant to flow therethrough”—FIG. 1: microchannel member 24, microchannels 30; specification, page 3, lines 24-27; page 4, lines 23-24.

“at least one thin film thermoelectric cooling (TFTEC) device in the at least one microchannel”—Fig. 1: TFTEC devices 40; specification, page 5, lines 5-8.

“a chipset in communication with the microprocessor”—FIG. 6: chipset 114; specification, page 8, line 26 to page 9, line 4.

Claim 24 (dependent on claim 23)

The support in the disclosure for the limitations inherited from claim 23 is described above in connection with claim 23. Claim 24 also recites:

“the at least one TFTEC device is formed on the rear surface of the IC die”—specification, page 5, lines 7-8.

**GROUND OF REJECTION TO BE REVIEWED ON APPEAL**

(1) Claims 1-9 and 11 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Messina (U.S. Patent No. 5,239,200) in view of Chu (U.S. Patent No. 6,489,551).<sup>1</sup>

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<sup>1</sup> The Final Office Action also includes other rejections under § 103(a), relying primarily the Messina and Chu references, plus other references as well. These rejections are not believe to raise any further issues that require consideration in this Appeal.

## ARGUMENT

### *I.     Applicable Law*

All of the issues in this appeal are related to rejections under 35 U.S.C. § 103(a). In these rejections, the Examiner found the claims at issue to be obvious in view of a proposed combination of the Messina and Chu references.

The recent Supreme Court decision in *KSR Int'l Co. v. Teleflex Inc.*<sup>2</sup> is now the leading case on the concept of obviousness. Quoting the statute, the Court observed that a patent may not be issued when

the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.<sup>3</sup>

The Court went on to note that “the combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results”.<sup>4</sup>

Addressing situations in which

the claimed subject matter may involve more than the simple substitution of one known element for another or the mere application of a known technique to a piece of prior art ready for the improvement ... [,]

the Court prescribed:

Often, it will be necessary for a court [or patent examiner] to look to interrelated teachings of multiple patents; the effects of demands known to the marketplace; and the background knowledge possessed by a person having ordinary skill in the art, all in order to determine whether there was some apparent reason to combine the known elements in the fashion claimed ... .

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<sup>2</sup> 127 S.Ct. 1729, 82 USPQ2d 1385 (2007)

<sup>3</sup> Slip opinion, at pp. 1-2.

<sup>4</sup> Slip opinion, at p. 12.

... [I]t can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does. This is so because inventions in most, if not all, instances rely upon building blocks long since uncovered, and claimed discoveries almost of necessity will be combinations of what, in some sense, is already known.<sup>5</sup>

## **II. Claim 1 is not obvious in view of the Messina and Chu references.**

Claim 1 is taken as exemplary of all of the rejected claims.

It seems to appellant that the invention recited in claim 1 is one that, like most inventions, is formed of previously known building blocks, but selected and arranged in a novel and unobvious manner. While the Examiner can fairly be said to have located the building blocks of claim 1 in the prior art, appellant does not believe that the Examiner has adduced any apparent reason that would lead one of ordinary skill in the art to combine those building blocks in the manner claimed.

The Messina reference discloses a cooling plate 20 which operates to conduct heat away from ICs 16. The cooling plate 20 has channels 22 formed therein, and coolant flows through the channels 22. The Examiner considered the channels 22 to be microchannels.

The Chu reference shows thin film thermoelectric cooling stages 20 and 24 provided to cool an IC chip 12. The TFTEC device 20 in Chu is formed between plates 30 and 32 and the TFTEC device 24 is formed between plates 40 and 42.

The Examiner's finding that claim 1 is obvious is stated as follows:<sup>6</sup>

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have a TFTEC as taught by Chu employed in the apparatus of Messina in order to provide active temperature control and reduce a leakage power consumption.

Appellant believes there are at least two ways in which this statement fails to provide a proper *prima facie* case of obviousness.

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<sup>5</sup> Slip opinion, at pp. 14-15.

<sup>6</sup> At page 3, second paragraph, of the Final Office Action.

The first deficiency in the Examiner's stated conclusion of obviousness is that the reason stated as justifying the combination of references is not supported by the references and does not appear related to the proposed combination. It does not appear to appellant that either of the references refers to active temperature control or reduction of leakage power consumption. While TFTEC devices may be said to provide active temperature control, such is also the case with a cold plate that includes microchannels with coolant flowing therein. There is no indication in the prior art that further active cooling, beyond that provided by coolant microchannels or TFTEC devices alone, is necessary or desirable. Thus the references do not provide any apparent reason for combining TFTEC devices and coolant microchannels together. Neither has the Examiner cited any further source of a reason for combining the references, even apart from the teachings of the references themselves.

By contrast, the present application describes the problems arising from hotspots on IC dies, and teaches that the combination of TFTEC devices in coolant microchannels is useful in addressing this specific problem. No such problem or benefit appears in the prior art cited by the Examiner.

A second flaw in the Examiner's statement of obviousness is that it does not even state that the prior art would result in placement of TFTEC devices in a microchannel. That is, the combination of references as formulated by the Examiner falls short of arriving at the invention as actually recited in claim 1. To reiterate, the Examiner has failed to assert that the combination of Messina and Chu would result in at least one TFTEC device in a microchannel, as recited in claim 1. Rather, the Examiner merely states that it would be obvious to employ a TFTEC in Messina's apparatus. Accordingly, on its face the Examiner's conclusion of obviousness is deficient in addressing the actual language of claim 1.

To recap the foregoing arguments, the Examiner has failed to adduce any valid reason grounded in the prior art for his proposed combination of admittedly old elements. Accordingly, the Examiner has failed to produce a *prima facie* case for modifying or combining the prior art to arrive at the invention recited in claim 1. Moreover, the Examiner has not even stated that the invention as actually recited in claim 1 would have been obvious in view of the prior art. The Examiner's rejection of claim 1 should therefore be reversed.

Appellant further notes that he has made of record in this case the Written Opinion of the International Searching Authority (in this case, the European Patent Office) rendered in the

corresponding PCT application. The EPO found that all of the claims appealed herein satisfy the inventive step requirement. The EPO noted that both coolant microchannels and TFTEC devices were known in the prior art, but found that “there is no hint in the prior art to provide microchannels through which a fluid flows with thin film thermoelectric cooling (TFTEC) devices.”

It seems to appellant that the EPO’s finding of “no hint” closely corresponds to the *KSR* standard of “no apparent reason to combine”. Thus an impartial observer has in effect found with similar art that the present invention should be patentable. While there is of course no requirement that the USPTO give deference to a PCT Written Opinion, nevertheless the principle of harmonization of international patent laws militates toward reaching compatible conclusions in regard to patentability. Thus the Written Opinion of the EPO in the corresponding PCT case provides further support for appellant’s position that the rejection of claim 1 should be reversed.

### **III. Separate argument in support of claim 2.**

Claim 2 is taken as exemplary of claims 2, 3, 24 and 25.

Claim 2 is dependent on claim 1 and should therefore be held patentable for the same reasons stated above in regard to claim 1. In addition, it is believed that there are independent grounds for the patentability of claim 2, apart from the patentability of claim 1.

Claim 2 adds the limitation that “the at least one TFTEC device is formed on the rear surface of the IC die”. The Examiner has apparently not directly addressed this limitation. While the Examiner acknowledged that the Messina reference does not disclose this limitation<sup>7</sup>, nowhere does he state either that Chu discloses this limitation nor that the combination of Messina and Chu would result in this limitation. Indeed, the disclosure of Chu would not support such an assertion, since in Chu the TFTEC elements 20, 24 are formed between support plates 30 and 32, or 40 and 42, not on the rear surface of the IC die 12.

Thus claim 2<sup>8</sup> should be held patentable even if claim 1 is not.

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<sup>7</sup> At page 2, last paragraph, of the Final Office Action.

<sup>8</sup> And claims 3, 24 and 25.



## CONCLUSION

For the reasons stated above, the Examiner's rejections of claims are improper. Therefore, appellant respectfully requests that the Examiner's rejections be reversed.

This Brief is filed within two months from the date of mailing of the Notice of Appeal (*i.e.*, within two months of March 18, 2008); as such, no extension of time is believed due. The \$510 fee for filing an Appeal Brief is paid herewith. However, if any additional fees are due in conjunction with this matter, the Commissioner is hereby authorized to charge them to Deposit Account 50-1852. An Appendix of claims involved in this appeal is attached hereto.

If any issues remain, or if the Examiner or the Board has any further suggestions for expediting allowance of the present application, kindly contact the undersigned using the information provided below.

Respectfully submitted,

May 13, 2008  
Date

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## APPENDIX A—CLAIMS

1. An apparatus comprising:
  - an integrated circuit (IC) die having a front surface on which an integrated circuit is formed and a rear surface that is opposite to the front surface;
  - a member to define at least one microchannel at the rear surface of the IC die, the microchannel to allow a coolant to flow therethrough; and
  - at least one thin film thermoelectric cooling (TFTEC) device in the at least one microchannel.
2. The apparatus of claim 1, wherein the at least one TFTEC device is formed on the rear surface of the IC die.
3. The apparatus of claim 2, wherein the member has a front side which faces the rear surface of the IC die, said front side of the member having at least one groove therein to define the at least one microchannel.
4. The apparatus of claim 1, wherein the member is an integrated heat spreader.
5. The apparatus of claim 4, wherein the member is formed of copper.
6. The apparatus of claim 1, wherein the member is formed of silicon.
7. The apparatus of claim 1, wherein the member is formed of copper.
8. The apparatus of claim 1, wherein the coolant includes water.

9. The apparatus of claim 8, wherein the coolant is de-ionized water
10. The apparatus of claim 1, wherein the TFTEC device includes one of silicon germanium superlattice and beryllium telluride.
11. The apparatus of claim 1, wherein the member is bonded to the rear surface of the IC die.
12. The apparatus of claim 11, further comprising a heat spreader;  
the member interposed between the heat spreader and the rear surface of the IC die;  
the at least one microchannel including:  
a first tier of microchannels defined by the rear surface of the IC die and by grooves in the member; and  
a second tier of microchannels defined by a rear surface of the member and grooves in the heat spreader, the second tier of microchannels being above the first tier of microchannels.
13. The apparatus of claim 12, wherein the at least one TFTEC device is formed on the rear surface of the IC die.
14. The apparatus of claim 11, further comprising a heat spreader;  
the member interposed between the heat spreader and the rear surface of the IC die;  
the at least one microchannel including:  
a first tier of microchannels defined by the rear surface of the IC die and by grooves in the member; and  
a second tier of microchannels defined by a front surface of the heat spreader and grooves in the member, the second tier of microchannels being above the first tier of microchannels.

15. The apparatus of claim 1, wherein the integrated circuit formed on the front surface of the IC die is a microprocessor.

16. The apparatus of claim 1, wherein the at least one TFTEC device includes at least one pair of stacked TFTEC devices.

17-22. (canceled)

23. A system comprising:

- an integrated circuit (IC) die having a front surface on which a microprocessor is formed and a rear surface that is opposite to the front surface;

- a member to define at least one microchannel at the rear surface of the IC die, the microchannel to allow a coolant to flow therethrough;

- at least one thin film thermoelectric cooling (TFTEC) device in the at least one microchannel; and

- a chipset in communication with the microprocessor.

24. The system of claim 23, wherein the at least one TFTEC device is formed on the rear surface of the IC die.

25. The system of claim 24, wherein the member has a front side which faces the rear surface of the IC die, said front side of the member having at least one groove therein to define the at least one microchannel.

26. The system of claim 23, wherein the TFTEC device includes one of silicon germanium superlattice and beryllium telluride.

27. The system of claim 23, further comprising:  
a coolant circulation system to supply the coolant to the at least one microchannel.
28. The system of claim 27, further comprising:  
a drive circuit to supply electrical power to the at least one TFTEC device.

## APPENDIX B - EVIDENCE

No evidence is being submitted with this Appeal Brief (*i.e.*, this appendix is empty).

## APPENDIX C - RELATED PROCEEDINGS

No prior or pending appeals, interferences, or judicial proceedings are known to Applicants, Applicants' legal representative, or assignee, which may be related to, directly affect, be directly affected by, or have a bearing on the Board's decision in the pending appeal. Therefore, there are no copies of decisions rendered by a court or the Board to attach (*i.e.*, this appendix is empty).